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I, JUDITH MARGARET ATKINSON, B.A., M.I.T.I. declare

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2. That I am well acquainted with the French and English languages.
3. That the attached is a true translation into the English language of International Patent Application No. PCT/FR2004/001910.
4. That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardise the validity of the patent application in the United States of America or any patent issuing thereon.

Declared this 7th day of December 2005

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HEALD FRAME AND WEAVING MACHINE EQUIPPED WITH AT LEAST ONE SUCH FRAME

The present invention relates to a heald frame, and to a weaving machine equipped with at least one such frame.

It is known to equip a weaving machine with heald frames which are to be driven in a vertically oscillating movement by means of an appropriate device, such as a heald loom or a dobby.

Such a heald frame first of all comprises a body which is formed by the reversible assembly of two posts and two cross-members. During operation, the posts are substantially vertical, while the cross-members are substantially horizontal. Each cross-member also supports a catching member, also called a bar, which permits the fixing of a corresponding end of the healds of the weaving machine.

The invention relates more particularly to such a heald frame which is provided with damping means interposed between the cross-members and the healds in the region of at least one end thereof. In this manner, during oscillation of the frame, some of the direct contact between the catching member and the healds is suppressed, which reduces the vibrations caused by the healds' rebounding on the bars and, consequently, the overall wear to which those various mechanical elements are subjected, while increasing the service life.

Heald frames are known which are provided with damping means against which a first end of the heald comes to bear

before the opposite end of the heald comes into contact with the corresponding catching member.

This known solution has a disadvantage, however, in that it induces substantial bending of the cross-member supporting the damping means. The cross-member is therefore subjected to considerable vibrations, so that it is weakened.

In the light of the above, the invention proposes to remedy that disadvantage of the prior art.

To that end, it relates to a heald frame for a weaving machine, said frame comprising two posts and two cross-members, each cross-member being provided with a catching member suitable for receiving a corresponding end of at least one heald of said frame, while there are also provided damping means which are integral with at least one corresponding catching member or cross-member and against which at least one end of the heald is capable of coming to bear, wherein, at least when said frame is in the stationary state and the heald is in a rectilinear configuration, when a first end of the or of each heald is bearing either on a first catching member in the region of its traction zone or on first damping means in the region of its compression zone, the other end of the or of each heald bears substantially either on other damping means in the region of its compression zone or on another catching member in the region of its traction zone.

The invention relates also to a weaving machine equipped with at least one heald frame as defined above.

The invention will be better understood, and other advantages will become more clearly apparent, in the light of the description which will be given hereinbelow of a weaving machine and of two heald frames in accordance with the principle of the invention, which are given solely by way of non-limiting examples and with reference to the accompanying drawings, in which:

- Figure 1 is a skeleton view, in diagrammatic form, of a weaving machine according to the invention;
- Figure 2 is a view in transverse section, according to line II-II in Figure 1, showing part of a heald frame belonging to the weaving machine of Figure 1, in particular with regard to the mutual fixing of a cross-member, a catching member and a heald belonging to the frame; and
- Figure 3 is a view in transverse section, analogous to that of Figure 2, showing a variant of the invention.

In Figure 1, a dobby 1 of a type known *per se* is intended to move a heald frame 2 belonging to a weaving machine M, according to a vertically oscillating movement indicated by the arrows F_1 and F'_1. To that end, a driving arm 1a of the dobby is coupled to each heald frame 2 by means of rods and oscillating levers. The machine M comprises a plurality of frames, generally from six to twenty-four, only one of which is shown in Figure 1 for the sake of clarity.

Each frame 2 comprises a body which is formed by the assembly of two posts 4, 4' and two cross-members 6, 6'. The posts 4, 4' extend generally in a direction parallel

to the direction of vertical oscillation Z-Z' of the frames, namely vertically during operation. In addition, the cross-members 6, 6' extend in a direction Y-Y' perpendicular to the above-mentioned direction Z-Z', namely horizontally during operation.

Each upper and lower cross-member 6 and 6', respectively, is equipped, in known manner, with a corresponding catching member or bar 8, 8'. The bars 8 and 8', which will be described in greater detail hereinbelow, permit the fixing of the upper and lower ends, respectively, of various healds 10 belonging to the frame 2 of the weaving machine M.

Figure 2 shows the fixing of the upper end of a heald 10 to the upper cross-member 6 by means of the bar 8. It is to be noted that the fixing of the lower end of the heald 10 to the cross-member 6' is carried out in an analogous manner by means of the bar 8'. With this in mind, the mechanical elements of the lower cross-member 6', of the lower bar 8' and of the lower end of the heald 10, which are analogous to those of the upper cross-member 6, the upper bar 8 and the upper end of the heald 10, respectively, bear the same numerals with the associated reference "prime".

The structure of the upper cross-member 6, which is conventional, will not be described in greater detail in the following. The bottom face of the cross-member 6, facing the heald 10, is prolonged by a rib 6_1 extending over the whole of the major dimension of the cross-member.

The rib 6_1 is prolonged by a lug 6_2 which, in transverse section, is substantially lozenge-shaped.

The catching bar 8 is formed by a thin metal sheet which has been folded back on itself, the thickness e of which is, for example, around 0.7 mm. It comprises first of all a region 8_1 permitting the fixing of the bar 8 to the cross-member 6 by cooperative shaping thereof.

More precisely, the fixing region is formed by two limbs 8_{21} and 8_{22} which are generally L-shaped and the angles of which are disposed facing one another in such a manner as to cover the above-mentioned lug 6_2. It is also to be noted that the limbs 8_{21}, 8_{22} constitute the free ends of the folded metal sheet forming the catching bar 8. The existence of the lug 6_2, associated with the limbs 8_{21} and 8_{22}, accordingly imparts a removable nature to the fixing of the bar 8 to the cross-member 6.

The two limbs 8_{21} and 8_{22} come together, facing the cross-member 6, in an intermediate region 8_3 of reduced transverse cross-section. Finally, the region 8_3 is prolonged by a region 8_4 which is intended to catch the heald 10, which will be described in greater detail in the following.

The heald 10 comprises, in conventional manner, a filiform element 10_1 provided with an eyelet 10_2, shown in Figure 1, for the passage of a warp thread (not shown). At each end of the heald, the filiform element 10_1 is prolonged by two principal limbs 10_3 which define a receiver 10_4 for receiving the bar 8. The mouth of the receiver is bordered

by two teeth 10_5 of the heald, which teeth extend towards one another to form a neck 10_6 of restricted transverse dimensions.

Returning to the catching region 8_4, that region has an approximately rectangular transverse cross-section, the dimensions of which are slightly greater than those of the intermediate region 8_3. In its lower portion remote from the cross-member 6, the catching region 8_4 forms a U-shaped reentrant portion 8_5, the core 8_{51} of which is turned towards the cross-member 6.

The reentrant portion serves to hold a damping element 12 of a type known *per se*, which is a flexible element made, for example, of a polymeric material, an elastomeric material or the like. Such a damping element, which extends over substantially the whole of the major dimension of the cross-member 6, is held by clamping and/or adhesive bonding in the U-shaped internal volume of the reentrant portion 8_5. It will be noted that the damping element 12 is received in the receiver 10_4 for receiving the bar 8.

When the weaving machine M is in its use configuration, the intermediate region 8_3 is received in the neck 10_6, while the catching region 8_4 is received in the receiver 10_4. The same is true of the lower end of the cross-member, the various mechanical elements being disposed symmetrically relative to the median horizontal axis of the frame 2.

More precisely, $\underline{s}_1$ denotes the surfaces of the upper catching bar 8 which are capable of coming to bear directly on the facing surfaces S_1 of the heald, belonging to the two teeth 10_5. The direct bearing surfaces $\underline{s}_1$ and S_1 form a traction zone of the heald, opposite the compression zone, corresponding to the free surfaces of the damping element 12 and those C_1 facing the heald 10.

Figure 2 shows the heald in a stationary state in which it is substantially rectilinear. When the upper end of the heald is bearing directly, by way of its surfaces S_1, against the facing upper surfaces $\underline{s}_1$ of the bar 8, the lower end of the heald bears substantially against the lower damping element 12', in the region of its lower compression surfaces C'_1. Of course, in a manner not shown in Figure 2, when the lower end of the heald is bearing directly, by way of its traction surfaces S'_1, on the surfaces $\underline{s}'_1$ of the lower bar 8', the upper portion of the heald bears substantially, by way of its upper compression surfaces C_1, against the upper damping element 12.

It should be noted that this arrangement is aimed at nominal manufacturing dimensions, it being understood that the manufacturing tolerances, in particular those relating to the straightness of the cross-members, enable these nominal dimensions to be achieved only approximately, in practice with greater or lesser deviations associated with these geometrical deviations. However, it is the average, or nominal, values which will obey the principle of the substantially simultaneous double contact, as mentioned above.

Such a measure is advantageous. The upper and lower cross-members 6 and 6', respectively, are subjected to vibrations during operation, which imparts a variable nature to their spacing. The healds come into contact with the bar and with the damping element, respectively, sometimes by way of their traction surfaces and sometimes by way of their compression surfaces, the impacts on the compression surfaces contributing to damping the vibrations.

The fact that substantially simultaneous bearing is provided on the lower or upper traction surfaces and on the upper or lower compression surfaces allows the cross-members 6 and 6' to be operated in a configuration in which the healds are substantially rectilinear. This is favourable to the transmission of a maximum compression force. One of the two cross-members, which acts as a damper, therefore absorbs a considerable force and allows the bending of the other cross-member to be reduced, then providing a traction force. In other words, the heald control force is transmitted by the two cross-members at the same time, which reduces the bending of the cross-members substantially by half.

Moreover, during oscillation of the frame 2, the presence of the upper and lower damping elements 12 and 12', respectively, enables the axial oscillation vibrations of the healds and their impacts on the bars to be reduced. This therefore brings about a reduction in the overall wear to which the healds and the bars are subjected and, consequently, an increase in their service life.

In Figure 2, the upper and lower bars 8 and 8' are equipped with damping means 12 and 12', respectively. It is possible, however, to provide only one of the bars 8 or 8' with such damping means, while the other bar 8' or 8 is devoid of such means. In that case, when the only damping means 12 or 12', which are integral with the bar 8 or 8', are in contact with the compression surfaces of the facing end of the heald, the other end thereof is advantageously in contact, by way of its traction surfaces S'_1 or S_1, with the other facing catching bar 8' or 8.

Figure 3 shows a first alternative embodiment of the invention. In that Figure, mechanical elements analogous to those of Figure 2 have been assigned the same reference numerals, increased by 100. As in the first embodiment, the mechanical elements of the lower cross-member 106', of the bar 108' and of the lower end of the heald 110 are analogous to those of the upper cross-member 106, the upper bar 108 and the upper end of the heald, respectively.

The heald 110 in this embodiment differs from the preceding example in that it is asymmetrical. Each of its ends is generally C-shaped, the filiform element 110_1 being prolonged by a single limb 110_3 from which there extend an intermediate tooth 110_{31} and a return portion 110_{32}. The tooth and the return portion, which are directed towards one another, define with the limb 110_3 two channels 110_{41}, 110_{42}.

In contrast to the preceding example, the catching bar 108 is fixed to the cross-member 106 by adhesive-bonding or

riveting means (not shown) or alternatively by other equivalent means. The catching bar 108 comprises a catching region 108_4, the ends of which penetrate into the channels 110_{41}, 110_{42}.

The cross-member 106 is further provided with a damping element 112 which is fixed, for example, by adhesive bonding. In contrast to the first embodiment, the damping element 112 is situated opposite the free end E of the heald, relative to the filiform body 110_1 thereof.

Analogously to the first embodiment, Figure 3 shows the heald 110 in the stationary state in which the heald is substantially rectilinear. When the upper end of the heald is bearing directly, by way of its surfaces S_{101}, against the facing upper surfaces $\underline{s}_{101}$ of the bar 108, the lower end of the heald bears substantially against the lower damping element 112', in the region of its lower compression surfaces C'_{101}. Moreover, in a manner not shown in Figure 3, when the lower end of the heald is bearing directly by way of its traction surfaces S'_{101} on the surfaces $\underline{s}'_{101}$ of the lower bar 108', the upper portion of the heald bears substantially, by way of its upper compression surfaces C_{101}, against the upper damping element 112.

The invention is not limited to the examples that have been described and shown.

For example, the heald may have a different form from that shown in Figures 2 and 3. For example, the heald may have a generally J-shaped cross-section, in a manner known *per*

se. In that case, the heald is equipped with a principal limb, while it is provided with only an upper return portion and does not have a lower tooth. The heald may also have an O-shaped cross-section, in a manner known *per se*, for frames equipped with sliders, likewise of the conventional type.

Moreover, the heald may have a generally C-, J- or O-shaped cross-section, while the damping means are received in the internal volume of the C, J or O, in contrast to the embodiment of Figure 3 and similarly to the embodiment of Figure 2. Moreover, the heald may be U-shaped, while the damping means are situated opposite the free end of the heald, relative to its filiform element, in contrast to the embodiment of Figure 2 and similarly to Figure 3.